Metrology of High Aspect Ratio MEMS

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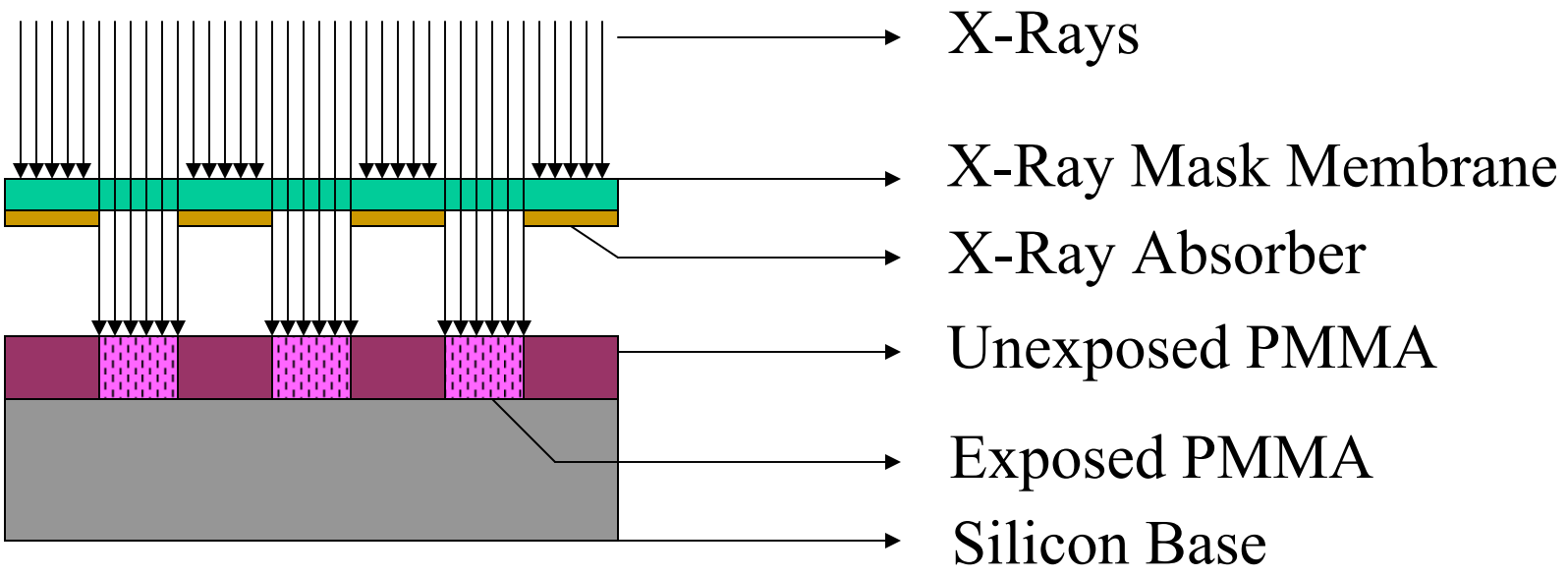
Overview

- Background information
- Current problems
- Objectives of research
- Current Status
- Expected Contributions

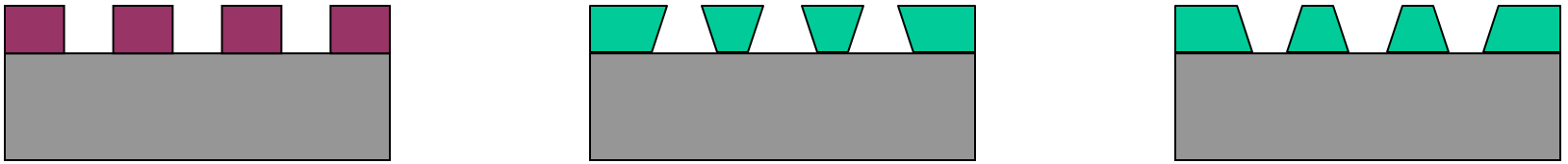
Background

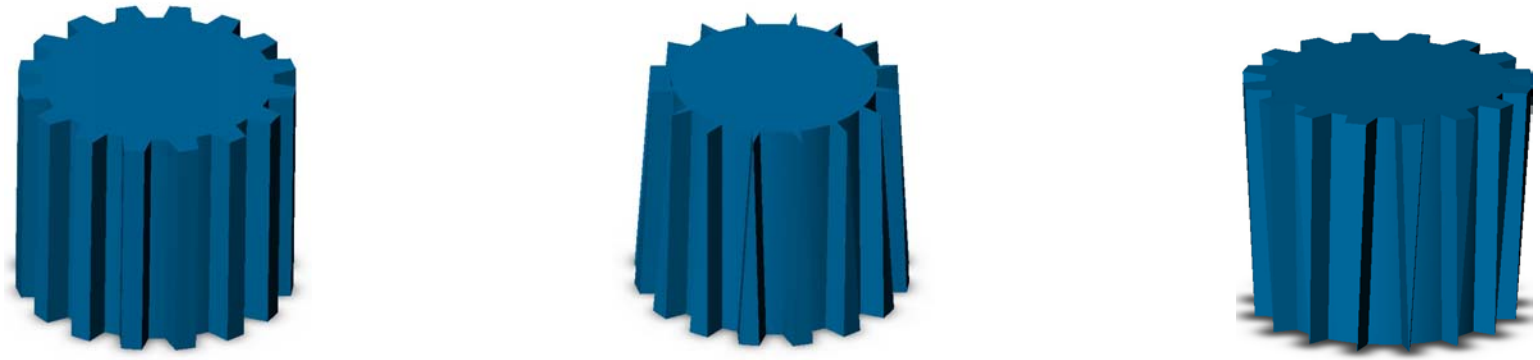


Illustrative Overview of LIGA process

LIGA Problems

- Various geometry outcomes due to overexposure, development, and post-processing





Ideal Overcut Undercut

LIGA Metrology

- Currently, no suitable 3-D data acquisition techniques for part verification
- Difficult to determine sidewall characteristics of high aspect ratio parts
- Most analyses of parts come from 2-D acquisition methods

LIGA Metrology

- Current 2-D techniques
  - SEM
  - Traditional optical microscopy
  - Stylus profilometry
- Current and Proposed 3-D techniques
  - White-light interferometry
  - Atomic force microscopy
  - Digital volumetric imaging
  - X-Ray tomography
  - Micro-interferometry

Proposed Research

- Develop methodology to correctly qualify the LIGA process
- Develop software which can analyze both 2-D and 3-D data sets in one environment
- Use methodology to improve process parameters of the fabrication method

Current Status

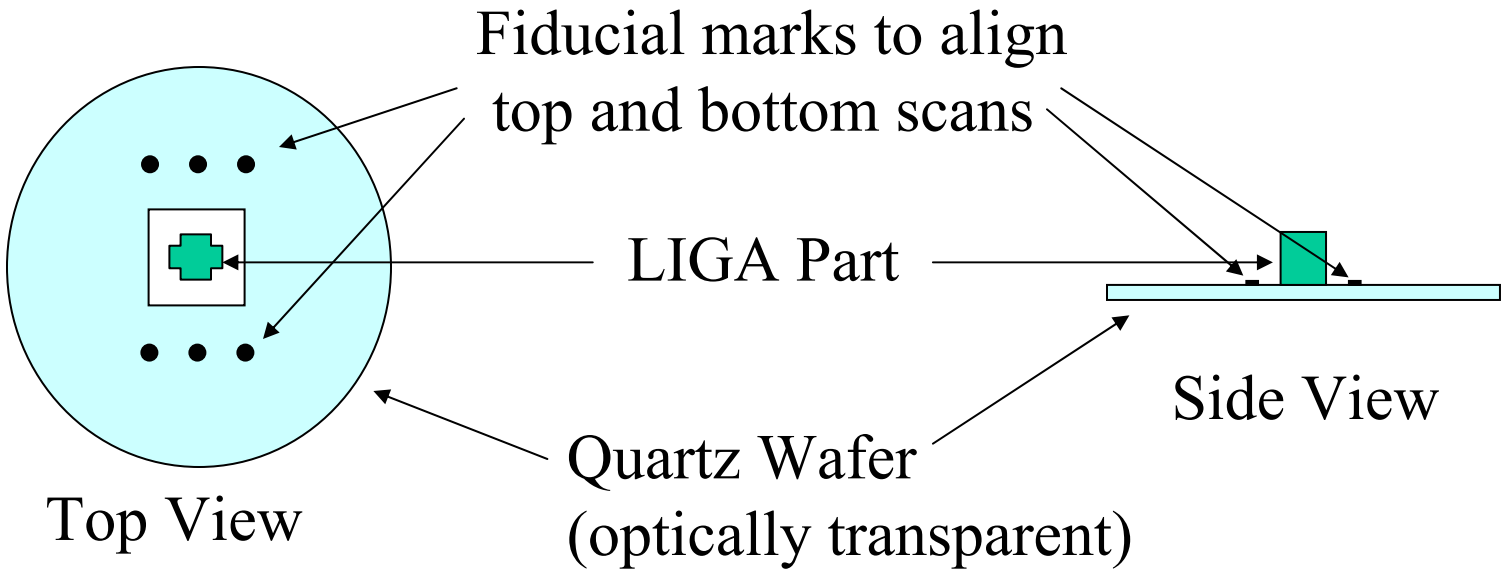
- Initial Hardware Study
  - Vision-based systems (2-D data)
  - White light interferometry (3-D data)

View Voyager

Veeco Optical Profiler

Current Status

- Initial Case Study
  - Inspection of LIGA top and bottom with vision-based system



Current Status

- Software Platform to analyze both 2-D and 3-D CAD models and point clouds
  - Input:
    - CAD Model (.sat format)
    - Point cloud (2-D or 3-D)
  - Output after best fit alignment:
    - Deviations (color map or whisker plot)
    - Scale factor
    - Translation between multiple point clouds
    - Rotation between multiple point clouds

Expected Contributions

- Robust software program to analyze 2-D and 3-D data sets
- Reliable methodology to inspect high-aspect ratio MEMS devices
- Improve fabrication steps by "closing the loop" in the manufacturing process